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Dated: December 16, 2003 Signature: _____
(Richard Zimmermann)

Docket No.: 28159/39798

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
APPLICATION FOR UNITED STATES LETTERS PATENT

Title:

CONSTRUCTIONAL ELEMENT, BUILDING SYSTEM AND METHOD OF CONSTRUCTION

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IMPROVED BUILDING SYSTEM

This is a continuation-in-part application of a co-pending application serial no. 10/398,888, filed on April 10, 2003.

FIELD OF THE INVENTION

The present invention relates to building systems, constructional elements and methods of construction.

DESCRIPTION OF THE PRIOR ART

Building systems in the form of prefabricated modular building systems have a tendency to rely upon heavy machinery for their construction, are generally labour intensive requiring many different tradesmen and, although being modular, require the separate construction and application of external and internal finishes. An example of components of a prefabricated modular building system is aluminium cladding. Such cladding is typically positioned and fixedly located on the exterior of a fibre panel or wood panel building structure.

Another example of modular elements for buildings includes a system comprising end posts and concrete slabs attached therebetween. These slabs may then be rendered or coated as necessary once the building is constructed.

SUMMARY OF THE INVENTION

According to one aspect of the invention, there is provided a building system for securing a plurality of adjacent constructional elements to form a wall, the system including:

at least two opposed posts positioned in use to define a space therebetween and adapted to secure respective ends of the elements, such that element ends are communicable with each other through the space.

Advantageously, the configuration of the invention allows for an improved and simplified system of construction. It also allows for improved location and interaction of utilities, such as electrical wiring, water supply via conduits, etc, from one constructional element to another through the space, and allows for the location and access of such utilities within a space within a constructional element.

The building system according to the present invention has been designed for use with constructional elements as described in the Applicant's co-pending International Patent Application No. WO 02/35026, however it will be appreciated by a person skilled in the art that it may be adapted for use with other applicable constructional elements.

Preferably, the system includes a base at which an end portion of each of the posts can be located. Also preferably, the base includes an upstanding spacer on outer or inner sides of which the posts are mounted to define the space therebetween. Preferably each post includes a central channel extending along at least part of its length, typically at least at its end portion. Preferably the spacer includes a projection which is

complementary to the central channel of the respective end portions of the posts.

Preferably the system allows the formation of two or more walls extending from the posts. Such walls may be linearly aligned, orthogonal, or acute/obtuse to each other.

In one embodiment, the system includes three posts allowing a junction of three walls extending therefrom. In another embodiment, the system includes four posts allowing a junction of four walls extending therefrom.

Preferably the constructional element includes:

a structural member;

cladding formed about the structural member such that at least one end of the structural member protrudes beyond one part of the cladding perimeter; and

abutment means including protrusion means formed in and protruding from another part of the cladding perimeter for mutual abutment and alignment with abutment means on an adjacent constructional element;

wherein the at least one end is adapted for location between two of the posts.

Also preferably, the constructional element includes:

a rectangular structural member;

cladding for covering the structural member and extending around sides and edges of the structural member such that at least one end of the structural member protrudes beyond the edge of the cladding at the sides and edges of the structural member; and

abutment means including protrusion means formed in and protruding from the cladding adjacent to an edge of the structural member for mutual abutment and alignment with abutment means on an adjacent constructional element;

wherein the at least one end is adapted for location between two of the posts.

Preferably the structural member is elongate, with opposing ends of the structural member protruding beyond respective opposing ends of the cladding for location between two of the posts. Also preferably, the structural member is hollow.

Preferably the constructional element includes utilities means including a utility service point on the element in communication with a utility supply conduit located within the structural member. The utilities services suppliable by the utility supply conduit may include any one of the following: electricity; telecommunications; gas; water; air conditioning; and vacuuming.

According to a second aspect of the invention there is provided a constructional element including:

a rectangular structural member;

primary cladding for covering the structural member and extending around sides and edges of the structural member such that at least one end of the structural member protrudes beyond the edge of the cladding at the sides and edges of the structural member; and

secondary cladding on one or more sides of the primary cladding.

Preferably the secondary cladding is located on opposing sides of the primary cladding. Preferably, the primary cladding is polymeric and the secondary cladding is glass reinforced concrete. Preferably the element further includes abutment means including protrusion means formed in and protruding from the cladding adjacent to an edge of the structural member for mutual abutment and

alignment with abutment means on an adjacent constructional element.

According to a third aspect of the invention there is provided a constructional element having a front face and an opposed rear face, the element including:

a structural member; and

cladding formed about the structural member such that, on the rear face of the constructional element, at least an end portion of the structural member is exposed.

Exposure of the structural element on the rear face of the constructional element allows the constructional element to be attached to a framework via the structural member, the framework including support elements.

It may be only an end portion of the structural member which is exposed to allow attachment of the structural element to a support element at its end, but preferably the structural member is exposed along the entire length of the rear face of the constructional element.

Preferably, the rear face of the constructional element is substantially flat. Preferably, the structural member includes an internal cavity, which may be hollow or filled with an insulating material.

Preferably, the structural member is a rectangular box section. Alternatively, the structural member may be a rectangular C-section opening to the rear face of the constructional element and having inwardly turned edge portions exposed. The exposed edge portions can then be used for attachment of the constructional element to a framework support element.

Preferably the element further includes abutment means including protrusion means formed in and protruding from another part of the cladding perimeter for mutual abutment and alignment with abutment means on an adjacent constructional element.

Preferably the protrusion means includes a tongue formed along one cladding edge portion, with the abutment

means further including a groove formed along the opposing cladding edge portion, the groove being adapted for receiving the tongue of an adjacent constructional element.

Alternatively, the abutment means includes complimentary step formations, the protrusion means being defined by a protruding step in a respective step formation.

Preferably, the structural member is metallic, fibreglass, or carbon fibre. The cladding may be cement, concrete, fibre cement, fibreglass, cellulose, foamed polymeric material, ceramics or polystyrene, or combinations thereof.

In one variation, the structural member can be one of two structural members, wherein the cladding is formed about both of the structural members.

According to a fourth aspect of the present invention, there is provided a method of panel or wall construction including:

providing a plurality of constructional elements as defined in the third aspect to form the panel or wall by the steps of:

mounting the constructional elements alongside one another such that they align, and adjacent constructional elements together form the panel or wall;

providing a support element; and

attaching each constructional element to the support element by attaching the exposed structural element at the rear face of the constructional element to the support element.

In one embodiment, the support element comprises a timber post and the constructional elements are attached to the timber post by means of fixing elements.

In another embodiment, the support element is a hollow metallic element such as a C-section and the constructional element is directly fixed to the support element.

In yet another embodiment the support element is a metallic post having one or more webs/flanges to which the structural element can be directly fixed.

According to a fifth aspect of the present invention, a building system is provided that includes:

a plurality of spaced apart support elements;

a plurality of constructional elements as defined in the third aspect, wherein the constructional elements are attachable to the support elements by attachment of the exposed portions of the structural elements to the support elements, and wherein the constructional elements are arrangable in a side by side relationship.

In one embodiment, at least one of the support elements comprises a T-section. Also, at least one of the structural elements is a star section having three projecting flanges.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Figures 1 and 3 are perspective views of a portion of a building system according to the present invention;

Figure 1a is a plan view of a base;

Figure 2 is a perspective view of the building system of Figure 1, with a post removed to reveal the space;

Figures 4 and 6 are perspective views of a corner of the building system;

Figure 5 is a reverse perspective view of the corner of Figure 4 with a post removed to reveal the space;

Figure 6a is a perspective view of a spacer for use with the building system;

Figures 7 and 8 are perspective views of a wall junction of the building system;

Figure 9 is a perspective view of another wall junction;

Figure 9a is a perspective view of another spacer for use with the building system;

Figure 10 is another perspective view of a portion of the building system;

Figure 11 is a perspective view of an alternative embodiment of the building system;

Figures 12, 13, and 15 to 17 are perspective views of variations of a board for use with the present invention;

Figure 14 is a detailed perspective view of the board of Figure 13;

Figure 18 is a side elevation of a wall according to the present invention;

Figure 19 is an exploded perspective view of an alternative embodiment of boards employed as louvres, illustrated in a closed position;

Figure 20 is a partial perspective view of the boards as louvres illustrated in Figure 19 in a closed position; and

Figure 21 is a partial cutaway perspective view of the building system of the present invention.

Figures 22 to 29 illustrate various embodiments of a building system in accordance with a further aspect of the present invention.

In the Figures, like reference numerals denote like parts.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The description in the Applicant's co-pending International Patent Application No. WO02/35026 is incorporated herein by reference.

Referring to the Figures 1 to 11 and 21, a preferred embodiment of the invention is a building system for securing a plurality of adjacent constructional members in the form of boards 10 in the form of a wall 12. The wall 12 may be a sidewall, floor, roof, ceiling, etc. The building system may be employed for forming a single room, garden shed, retaining wall, garden feature wall, or multi-room/multi-level house, for example. Also, the building system may be used in combination with other building systems. For example, when building a multi-room dwelling, the building system of the present invention may be used to form external walls only, while a conventional building system may be used to form internal walls.

The board 10 is typically in the form described in PCT/AU01/01375, including a rectangular structural member in the form of an elongate hollow box core 14, and cladding 16 about the core. Ends 18 of the core 14 of the board extend beyond respective ends 20 of the cladding 16.

At least two opposed posts 22 are positioned in use to define a space 24 therebetween. The opposed posts 22 are adapted to secure respective ends 18 of the boards 10 in the form of a wall and such that ends 18 of the boards 10 are communicable with each other through the space 24. For example, in Figure 2 one of the opposed posts 22 has been removed to reveal the space 24 between the posts 22. Utilities in the form of telecommunication and electrical wires 26 can be seen to pass through the space 24 from an end 28 of one board 30 to adjacent end 32 of a second board 34. It is in this manner that ends 18 of the boards 10 are communicable with each other through the space 24.

These utilities may then be accessed, for example, through the cladding 16 of a board 10. For example, as

illustrated in Figure 7, an electrical point 35 is located on a board 10, the point 35 being in communication with the wiring 26 within the board 10.

Furthermore, it will be apparent to those skilled in the art that this communication is not limited to adjacent ends 18 of boards in series, such as boards 30 and 34 illustrated in Figure 2, but that any one of the boards 10 within the space 24 may communicate through the space 24 with any other boards whose ends 18 are in the space 24. Also, if the building system is employed to form a multi-level house for example, electrical wiring may run from a ceiling, and down through the space 24 and then through any one of the boards 10 whose ends 18 are in communication with the space 24. This would allow, say, for a light in the ceiling to be easily wired and connected to a light switch on a board 10. Other examples of utilities which may be supplied through the boards 10 and the space 24 also include air conditioning (hot or cold), vacuum supply, gas supply and water.

In the preferred embodiment of the building system, there are three forms of the posts 22. The form of post used depends on the type of wall 12 or wall junction to be formed by the posts 22. The first type of post 22 is a straight post 36, as illustrated in Figures 1, 2, 3, 7, 8 and 10. The second type of post 22 is a small angle post 38, as illustrated in Figures 4 to 9. The third type of post 22 is a large angle post 40, as illustrated in Figures 4 and 6.

The posts 22 are usually rolled or folded from 2-5mm thick steel plate, though may be formed from other plate material and thicknesses, depending on the application.

As illustrated for example in Figure 1, the straight post 36 is employed with another straight post 36 to allow

the formation of two walls 12 extending from the posts 36, where the walls 12 are on a mutual plane. As illustrated for example in Figure 7, two small angle posts 38 may be used in combination with a straight post 36 to form a junction of two walls on a mutual plane and a third wall extending perpendicularly from the two walls. Alternatively, as illustrated for example in Figure 9, four small angle posts 38 may be used to form a junction of four walls extending from the posts 38 at right angles from each other. Or, one small angle posts 38 may be used in combination with one large angle post 40 to form a junction of two walls extending from the posts at right angles to each other. In alternative embodiments of forms of the post (not shown), other wall junctions may be formed, for example allowing walls to join at different angles with respect to each other.

The building system preferably includes a base 42 at which an end portion 44 of each of the posts 22 can be located. As illustrated for example in Figure 6, the base includes a mounting plate 46, for mounting to a foundation pillar 48 by attachment devices in the form of bolts 50. The base 42 includes an upstanding spacer 52, the outer sides to which the posts 22 are mounted to define the space 24 between the posts 22. The spacer 52 is usually spot welded to the base plate 46. The spacer 52 usually includes a large portion 54 and one or more small portions 56, depending on the type of wall junction it is used with. For example, when used in a junction of two perpendicular walls extending from a single large angle post 40 and a single small angle post 38, as illustrated in Figure 6, the spacer includes the large portion 54 with two small portions 56 disposed at 90° with respect to each other about the large portion 54. Alternatively, when

used in a junction of two walls in a mutual plane extending from a pair of opposed straight posts 36, as illustrated in Figure 1, the spacer includes the large portion 54 with two small portions 56 disposed in line with the large portion 54. When used in a junction of three walls, two in a mutual plane, and the third wall extending perpendicularly therefrom, as illustrated in Figure 7, the spacer includes the large portion 54 with three small portions 56, where two small portions 56 are disposed in line with the large portion 54, and the third small portion 56 is disposed at 90° with respect to the line between the other two small portions 56. Lastly, when used in a junction of four walls, as illustrated in Figure 9, the spacer includes the large portion 54 with four small portions 56, disposed at 90° with respect to each other about the large portion 54. As illustrated in Figure 6, the spacer may also be employed separate from the mounting plate 46 in a different location in the space 24 to aid in defining the space 24 along the length of the posts 22. For this reason, the spacer 52 is hollow so as not to interrupt communication through the space 24. In an alternative embodiment, the spacer only includes the large portion 54.

In another alternative embodiment of the invention, illustrated in Figure 11, additional caps 57a and 57b are used to further secure the posts 22 about the spacer. The caps 57a and 57b are usually screw-attached to respective posts 22. In the embodiment of the caps 57a and 57b illustrated in Figure 11, a separate base plate 46 is not required, as it is in two parts 46a and 46b, each part being integral with caps 57a and 57b respectively. In another form (not shown) the caps are separate to the base plate 46. When caps are employed, it is usually not

necessary to use the small portions 56 of the spacer 52. Also, the use of caps 57a and 57b can replace spacer 52, with the caps then co-operatively functioning as the spacer.

Each post 22 includes a central channel 58, preferably along its entire length, though in alternative embodiments the channel may be along part of its post's length. The channel 58 both increases the rigidity of the posts 22 along their length and is complementary to the relative part of the spacer 52 to which the post 22 abuts in use.

In use, the building system may include load bearing beams 60 for supporting a preformed floor 61 or ceiling. Alternatively, the beams 60 may support a floor or ceiling formed from boards 10. The beams are usually c-section beams, though may be in other forms. As illustrated in Figure 6, the beams 60 may extend either from the posts 22 or from another beam 60.

Alternatively, as illustrated in Figure 10, the pillar 48, base 42 and end portions 44 of the posts 22 may be located below ground level, in a ground 65, the ground being either natural or in-filled. The floor 61 may then be laid on the ground, with the option of using an expansion joint 67 between the floor 61 and the posts 22 and boards 10.

The boards 10 are usually secured to the posts 22 by self-tapping screws 63. The core 14 of the boards 10 ideally has two internal ribs 62 along the length of the core 14 to define a utilities hollow 64 and two void hollows 66 within the core 14. As illustrated in Figure 1, for example, utilities, such as electrical cabling are located in the utilities hollow 64. Since the boards 10 are secured to the posts 22 on a section of the core 14

corresponding to the void hollows 66, the potential for the screws to damage or obstruct installation of the utilities in the board 10 is removed. As will be appreciated by those skilled in the art, whereas having two internal ribs 62 within the core 14 is ideal, it is not essential to the working of the invention.

The part-formed walls illustrated in Figures 2 and 6 show how the boards 10 may be further clad by sheet cladding 68, covering the entire wall surface. Alternatively, each individual board 10 may have preformed secondary cladding 70, as illustrated in Figures 12 to 14. This is particularly useful when the board 10 is used to form an internal wall, where it is not necessary to singularly clad the structural member 14 in a heavy material, such as glass reinforced concrete (GRC) typically suited for an external wall having a surface exposed to natural elements such as sun, rain, etc. Therefore, when merely used to form an internal wall, the board 10 may be clad in primary cladding 72 of a lighter, less durable material such as polystyrene or wood-pulp based material, for example. This primary cladding may then be clad by secondary cladding 70 of GYPROC®, or another appropriate material such as GRC. This variation on board manufacture aids in reduction of weight and cost of the board 10. Furthermore, depending on the use of the board 10, it may only require secondary cladding 70 on one side, as illustrated in Figure 12.

Alternatively, as illustrated in Figure 15, the structural member may only be clad about three of its four sides, depending on the requirement for the end use of the board 10. Furthermore, as illustrated in Figures 16, 17 and 18, recesses 74 may be formed in the cladding to expose a portion of the structural member 14 for easier

attachment thereto of a brace member 76. As illustrated in Figure 17, the brace member 76 may be employed for connection of a board 10 mid-way along another board. For example, this may be necessary if a perpendicular wall is required at a location away from the posts 22.

Figures 19 and 20 illustrate an embodiment of the board 10 adapted for use as louvres. In this embodiment, the board 10 has abutment means in shiplap form 78. Louvre connection devices 80 are connected to ends 18 of respective boards 10 to allow a standard louvre operation, the connection devices 80 being rotatably mounted to posts by protrusions 82 on the connection devices 80. Movement arms 84 extend from the connection devices 80 for attachment to an operating arm (not shown) to allow manual opening and closing of the louvres.

Now that the preferred embodiments of the invention have been described, it will be apparent to those skilled in the art that the improved building system has at least the following advantages:

1 It allows for easier access and deployment of utilities;

2 The post configuration is lighter than present methods; and

3 The post configuration is cheaper to manufacture than present methods.

Figures 22 to 29 illustrate embodiments of a building system for securing a plurality of constructional elements in the form of boards 10 to form a panel or wall. In the embodiments of Figures 22 to 28, each board 10 includes structural members in the form of two hollow closed section cores 101, which are covered on three faces of the board 10 by cladding 100. On the three fully clad faces of the board 10, the cladding 100 extends to the

ends of the cores 101. On the rear face of the board, at least a portion of the cores 101 are exposed, the exposed portion of each core 101 being at least a portion adjacent to an ends of the board 10. The board 10 may be fixed to a frame by means of attachment to the exposed portions of the cores 101 at the rear face of the board 10.

Figures 22 and 23 illustrates embodiments for attachment to a timber frame including support elements in the form of timber posts 102. In the embodiment of Figures 22 and 23, the boards 10 are only clad on three faces such that the cores 101 are exposed along their entire lengths at the rear face of the board 10.

In the embodiment of Figure 22, a fixing channel 103 is screwed to the exposed rear face of a one of the cores 101, and a fixing channel 104 is screwed to the posts 102. A downward facing flange 103a of fixing channel 103 slots behind an upward facing flange 104a of fixing channel 104. To construct a wall or panel, the boards 10 are slotted into position starting at the bottom of the wall or panel. The boards 10 typically also include abutment means in the form of tongue and groove edge sections on adjacent boards which interlock.

In the embodiment of Figure 23, the boards are fixed to timber posts 102 by means of L shaped fixing clips 105 which are screwed to both the timber posts and the exposed rear surface of core 101.

If a metal frame including hollow metal sections is used, as shown in Figure 24, the boards may be fixed directly to upright posts 102 which, in this embodiment, comprise metal C-sections. Self-tapping screws 110 fix the C-sections into the exposed rear face of the core 101.

Figures 25 and 26 illustrate embodiments of the building system including connecting members 106 for

joining ends of adjacent boards to form corners as shown in Figure 25 or to join boards end to end as shown in Figure 26. Figure 25 illustrates a corner junction in which a star shaped metal section 106 having three projecting flanges is used. Abutting boards 10 are fixed to two of the projecting flanges 106a, 106b and the third flange 106c projects between the end faces of the abutting boards 10. In Figure 26, a T section 106 is used to connect two boards 10 in a line.

Advantageously in the embodiment of Figures 25 and 26 no quoins or covers are required at the joints or corners.

Figure 27 shows an arrangement of boards around a window frame 200.

In the embodiment of Figure 28, only the end portions 107 of the cores 101 are exposed on the rear face of the board 10 where they are attached to the T shaped or star shaped connecting members 106.

Figure 29 illustrates an embodiment in which the core 101 is a C-section rather than a rectangular box section as shown in Figures 22 to 28. The board 10 is attached to a metal or timber post by fixing to inward facing edge portions 109a, 109b of the C section core 101 which are exposed at the rear face of the board 10.

Advantageously by partially removing at least a portion of the cladding on the rear face of the boards, a strong bond between board and frame can be established, without the need to protrude the core(s) beyond the end of the cladding for fastening.

Although the invention has been described with reference to particular examples, it will be appreciated by those skilled in the art that the invention may be embodied in many other forms.

It is to be understood that any reference to prior art herein does not constitute an admission that the information forms a part of the common general knowledge in the art, in Australia or any other country.